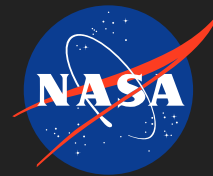


National Institute of Occupational Safety and Health (NIOSH) Partnered Development of Cryogenic Life Support Technologies

Active Technology Project (2012 - 2018)



Project Introduction

Cryogenic life support technology, used by NASA to protect crews working around hazardous gases soon could be called on for a number of life-saving applications as well as the agency's new human spaceflight endeavors. This technology under development in Kennedy Space Center's Biomedical Laboratory has the potential to store more than twice the amount of breathable air than traditional compressed gas systems. The National Institute for Occupational Safety and Health (NIOSH) is contributing to the funding for this project in the hopes that the liquid air-based systems could change the way workers dependent on life support technologies accomplish their mission, improving their safety and efficiency.

NASA researchers at Kennedy Space Center (KSC) have partnered with NIOSH to advance the current state of the art in cryogenic life support technologies to the point where it can be successfully commercialized. The technologies developed under this project will benefit future NASA rescue and ground operation missions and hopefully expand cryogenic life support technology to mining, hazmat, fire/rescue, DOD, and any other sector that uses life support devices.

Sub-projects Include: advanced liquid air self contained breathing apparatus (SCBA) packs, liquid air storage and fill stations, liquid oxygen rebreather technologies, liquid air based refuge chamber technologies, liquid air SCBAs with liquid cooling garments, and liquid oxygen storage in "cryo-capacitors". The overall partnership between NIOSH and NASA started in 2012 and is presently ongoing. Some of the projects are on their way to commercialization. Specific objectives are to conduct a feasibility studies for cryogenic air and oxygen applications, to fabricate, test, and document operational prototype supply systems. The Cryogenic Refuge Alternative Storage System is presently in its third generation and scheduled for extensive testing in NIOSH's own test mine where it is hoped that it will be certified for sale as a commercial product.

Anticipated Benefits

Benefits to NASA include improved ground operations safety and reduced cost of operation due to indefinite storage technology. This technology is the next generation crew rescue packs; next generation



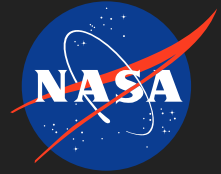
2hr liquid air pack with quick fill and attitude independent pickup

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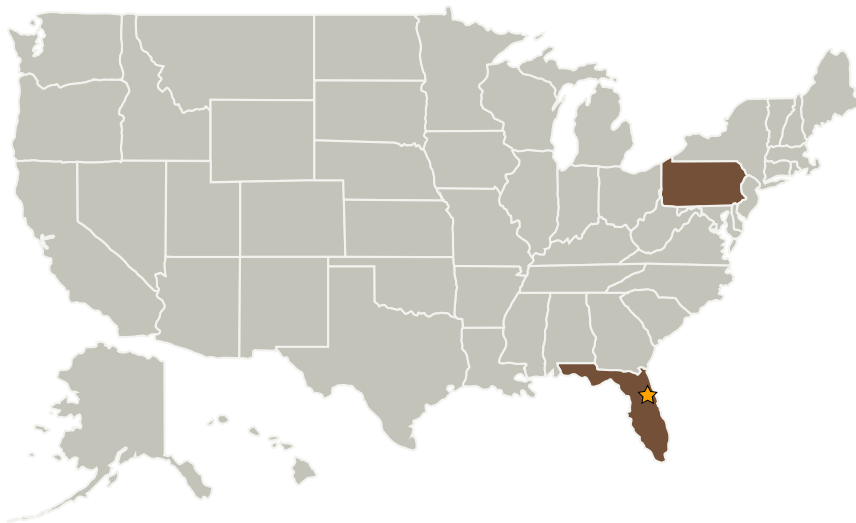
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of crew rescue packs for use in escape, rescue, and shelter during an emergency. However, if this technology is successfully commercialized, every sector that is dependent on life support equipment could potentially benefit by devices that improve safety, and improve efficiency. For example, by cooling firefighters and providing them with more breathable air, one firefighter can now double the time they can stay in a hot environment.

Primary U.S. Work Locations and Key Partners



Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Independent Research & Development: KSC IRAD

Project Management

Project Manager:

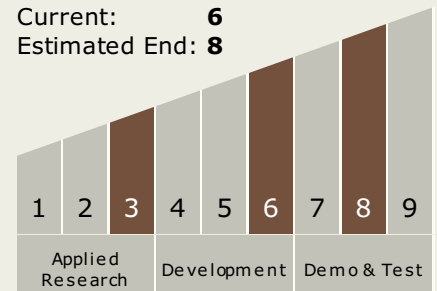
David R Bush

Principal Investigator:

David R Bush

Technology Maturity (TRL)

Start: 3
Current: 6
Estimated End: 8



National Institute of Occupational Safety and Health (NIOSH) Partnered Development of Cryogenic Life Support Technologies

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| Organizations Performing Work | Role | Type | Location |
|--|-------------------------|-----------------|--------------------------|
| ★ Kennedy Space Center (KSC) | Lead Organization | NASA Center | Kennedy Space Center, FL |
| National Institutes Occupational Safety and Health (NIOSH) | Supporting Organization | U.S. Government | |

| Co-Funding Partners | Type | Location |
|--|-----------------|----------|
| National Institutes Occupational Safety and Health (NIOSH) | U.S. Government | |

| Primary U.S. Work Locations | |
|-----------------------------|--------------|
| Florida | Pennsylvania |

Images



Cryogenic Air Storage and Fill Station

Indefinite storage of 425L liquid air with 4 fill lines

Technology Areas

Primary:

- Human Health, Life Support, and Habitation Systems (TA 6)
 - └ Environmental Monitoring, Safety, and Emergency Response (TA 6.4)
 - └ Protective Clothing and Breathing (TA 6.4.3)

Other/Cross-cutting:

- Ground and Launch Systems (TA 13)
 - └ Mission Success (TA 13.4)
 - └ Safety Systems (TA 13.4.5)

Target Destinations

Earth, Foundational Knowledge

National Institute of Occupational Safety and Health (NIOSH) Partnered Development of Cryogenic Life Support Technologies

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Cryogenic Breathing Apparatus

2hr liquid air pack with quick fill
and attitude independent pickup

Stories

Infusion Story - Development and Testing of an Advanced Cryogenic Breathing Apparatus for Mine Escape
(<https://techport.nasa.gov/file/32699>)

Success Story - Advanced Cryogenic Breathing Apparatus
(<https://techport.nasa.gov/file/32700>)

Success Story - Cryo Life Support
(<https://techport.nasa.gov/file/26335>)

Success Story - Cryogenic Refuge Alternative Supply System
(<https://techport.nasa.gov/file/32698>)

Project Website:

http://www.nasa.gov/content/nasa-technology-may-breathe-life-safety-into-mines/#.Uxn9M_m9l8E